Weston & Sampson

55 Walkers Brook Drive, Suite 100, Reading, MA 01867
Tel: 978.532.1900

MEMORANDUM

TO: Rick Mattson, Director of Public Works

CC: Bernie Marshall, Water & Sewer Superintendent

FROM: Kate J. Perotti, PE

DATE: November 30, 2020

SUBJECT: Cedar Crossing Capacity Study

Weston & Sampson Engineers, Inc., is pleased to submit this technical memorandum as part of the agreement for engineering services for the Cedar Crossing & Cedar Edge Development in the Town of Walpole, Massachusetts. This report includes a summary of previous studies of sewer lines and a theoretical hydraulic capacity analysis of sewers between 55 Summer Street and the town's interceptor. This information was collected by Weston & Sampson on behalf of the Town of Walpole through previously performed projects. No additional field work or verification of data was performed as part of this project. In the summarization and interpretation of existing data, Weston & Sampson is acting on behalf of and as an agent of the Town of Walpole.

The purpose of this project is to provide a summary of physical assessments of sewers and manholes downstream of the proposed connection. Evaluation and removal of infiltration and inflow (I/I) was not included as part of this project.

Project Background & System Description

Omni Development, LLC, is proposing to construct a 300-unit 40B residential community at 55 Summer Street in South Walpole. A total of 572 rooms are proposed to discharge wastewater flow via a combination of gravity pipelines and low-pressure force main within the development; wastewater flow from the development is proposed to be discharged to the town's sewer system via force main. Pumping rates for the proposed pump station were not available at the time of this review; therefore Title 5 rates for gravity discharge were utilized for this technical memorandum. The proposed maximum daily wastewater discharge for the new development is 62,920 gallons per day (gpd) based on 110 gpd per bedroom, as per Title 5 regulations. It is estimated that the average daily flow will be approximately 41,947 gpd and the estimated peak flow is approximately 209,735 gpd based on a peaking factor of 5.0[1]. Please note these values may change once pump station information is provided. The Town of Walpole requires that an evaluation of the impact of the proposed wastewater flow on downstream sewers be performed prior to permitting the sewer connection.

The system downstream of the proposed connection consists of approximately 17,771 linear feet (lf) of sanitary sewers in Subareas 13, 12, and 6 before reaching the town's interceptor. In its proposed location, wastewater flow would travel from Summer Street to Neponset Street and Willow Street, down Washington Street, Georgia Drive and Barbara Road to Sandy Valley Drive, South Street, Oak Street, and finally to Lewis Avenue where it connects with the town's interceptor. Review of sewer segments between the proposed sewer connection and the town's interceptor are included herein. The sewers are shown in the attached Figure 1, and hereafter referred to as the Project Area.

---

[1]*Gravity Sanitary Sewer Design and Construction (2nd ed.).* (2007). American Society of Civil Engineers (ASCE) and Water Environment Foundation (WEF)

Review of Existing Data
The following is a summary of previous work performed in the Project Area.

Flow Metering
Town-wide flow metering was conducted for a 12-week period from March 20 through June 16, 2009 to obtain sewer system flow data for use in quantifying I/I rates. A flow meter was installed in manhole 6-042 to measure flow from Subarea 12 and in manhole 13-001 to measure flow from Subarea 13. According to metering data, the instantaneous peak flow experienced at meter 6-042 was approximately 603,000 gpd and at meter 13-001 was 562,000 gpd. The location of the meters is shown in Figure 1.

Recent Construction
Home2 Suites by Hilton was constructed at 2375 Boston Providence Highway (Route 1) in South Walpole. It consists of 116 hotel rooms and opened in May 2018. Wastewater flow discharges via gravity to the town's sewer system in Jason's Path easement. The maximum daily wastewater discharge for the hotel is 12,760 gpd and the average daily flow is 8,507 gpd. Using a peaking factor of 5.0[1], the increased peak flow to the town's collection system was 42,535 gpd. This flow rate was used to calculate the existing flow in Table 1.

Flow Isolation of Sanitary Sewers
Flow isolation is a means to measure infiltration rates in manhole-to-manhole reaches of sewers and is performed during periods of high groundwater and minimum wastewater flow, such as early morning hours in the spring season. Flow isolation of approximately 855 lf of 12-inch sewers within the Project Area was performed in April 2018. The flow isolation measured a total of approximately 6,356 gallons per day (gpd) of infiltration. Approximately 16,916 lf of sewers are greater than 12-inches in diameter and could not be safely or effectively isolated to accurately gauge the concentration of infiltration.

Television Inspection
Television inspection is conducted to locate and document defects within sewers and to make direct observations of infiltration rates. Prior to television inspection, each sewer segment is cleaned by a high-pressure hydraulic sewer cleaner. A total of 17,729 lf of sewers in the Project Area were cleaned and television inspected in April 2012 and May 2018.

Approximately 24,624 gpd of peak infiltration was observed during the television inspection. An additional 7,920 gpd of unidentified tap flow was observed. Unidentified tap flow is any flow originating from a tap that appears to be infiltration; however, a specific defect could not be observed during the inspection.

Estimates for infiltration measured through flow isolation and observed through television inspection may vary due to several factors, including difficulty in determining infiltration rates due to sags, heavy flow, and active/running taps.

Topside Manhole Inspection
Topside inspections of 71 sewer manholes in the Project Area were performed in April 2012 and May 2015. Location, diameter, depth, material, casting and cover size, and source of any observed infiltration were recorded for each manhole. An estimated 3,024 gpd of infiltration was identified in nine (9) manholes. Inspections were not performed on 10 manholes because they could not be opened or could not be located at the time of inspection.

Rehabilitation & Pipeline Condition
During the Fall/Winter of 2015 and the Summer/Fall of 2020, sewer rehabilitation programs were performed, whereby cost-effective and value-effective repairs were made to reduce infiltration. Some defects were not

repaired because they were not deemed to be cost-effective at the time. However, the overall condition of pipelines in the Project Area is generally good.

Theoretical Hydraulic Capacity Analysis

A detailed evaluation of the hydraulic capacity of sewers downstream from the proposed connection was performed to determine whether the pipe capacity is adequate for existing plus proposed future flow. The theoretical hydraulic capacity of individual sewer segments was determined utilizing Manning's Equation for open channel flow assuming clean, circular pipe in good condition without debris or obstructions. The capacity of gravity sewer pipes depends on pipe diameter, slope, and material. These factors were obtained from record drawings as provided by the town and verified through field survey and television inspection data, where available. The hydraulic capacities of individual pipe segments were calculated using Manning's Equation given by:

$Q = (1.49/n)R^{2/3}S^{1/2}A$, where:

- Q = Hydraulic capacity, cubic feet per second
- n = Coefficient of roughness
- R = Hydraulic radius, feet
- S = Slope
- A = Cross-sectional area, square feet

The coefficient of roughness is dependent upon the pipe material. The hydraulic capacity of each segment assumes a clean, circular, non-obtrusive pipe, flowing at 100% full. Design capacity is estimated to be 80% of the pipe's full capacity to allow for a factor of safety. Available capacity was calculated by subtracting the existing flow data from the design capacity.

Existing flow data for each individual pipe segment is not available. Therefore, for the purpose of determining existing flow, the 2009 peak instantaneous flow measured at manhole 6-042 was used to evaluate hydraulic capacity in sewer pipelines between manholes 13-001 and 6-042. Similarly, the peak instantaneous flow measured in manhole 13-001 was used to evaluate hydraulic capacity in sewer pipelines from the proposed development discharge (manhole 13-027) to manhole 13-001. The existing flow used in the hydraulic capacity analysis includes the proposed peak flow from the development (209,735 gpd) as well as the proposed peak flow from the recently constructed Home2 Suites by Hilton (42,535 gpd). This represents a conservative approach.

The hydraulic capacity analysis for the Project Area was performed for pipe segments beginning at manhole 13-027 on Summer Street to manhole 6-042 on Lewis Avenue. Hydraulic capacity of individual pipes increases and decreases nominally from segment to segment; however, the total hydraulic capacity throughout the flow path remains generally consistent. Three pipe segments on Summer Street, Sandy Valley Drive easement, and South Street exceeded design capacity. These locations are shown in Figure 1.

While the table shows the pipe segment adjacent to where the proposed connection would be made as deficient, existing flow in Summer Street pipe segments is assumed to be much lower than reported in the table. Because flow data for individual pipe segments was not available in that area, existing flow is based on peak flows observed at manhole 13-001. Therefore, this segment is not noted as an area of concern.

Two segments, one in the Sandy Valley Drive easement and one on South Street, are shown as deficient in Table 1. Both of these segments have parallel relief sewers to handle additional flow. Therefore, these segments are not noted as areas of concern.

Some assumptions, including pipe material and slope calculations, were made as this data was not available on record drawings. It is important to note that it is not always accurate to assume a clean, circular pipe. Sags, obstructions, offset joints, tuberculation, and debris can all cause a reduction in capacity. This negatively impacts the pipeline capacity by decreasing the diameter and increasing friction in the pipe. Calculations and assumptions for the hydraulic capacity analysis can be found in Table 1, Sewer Line Hydraulic Capacity Analysis.

The results of the theoretical hydraulic capacity calculations were verified using observed flow levels in individual pipe segments based on the television inspection data noted on Page 2 of this memorandum. During the inspections, which occurred during springtime/high groundwater periods, pipes in the Project Area were flowing less than 50% full and no evidence of surcharging was observed.

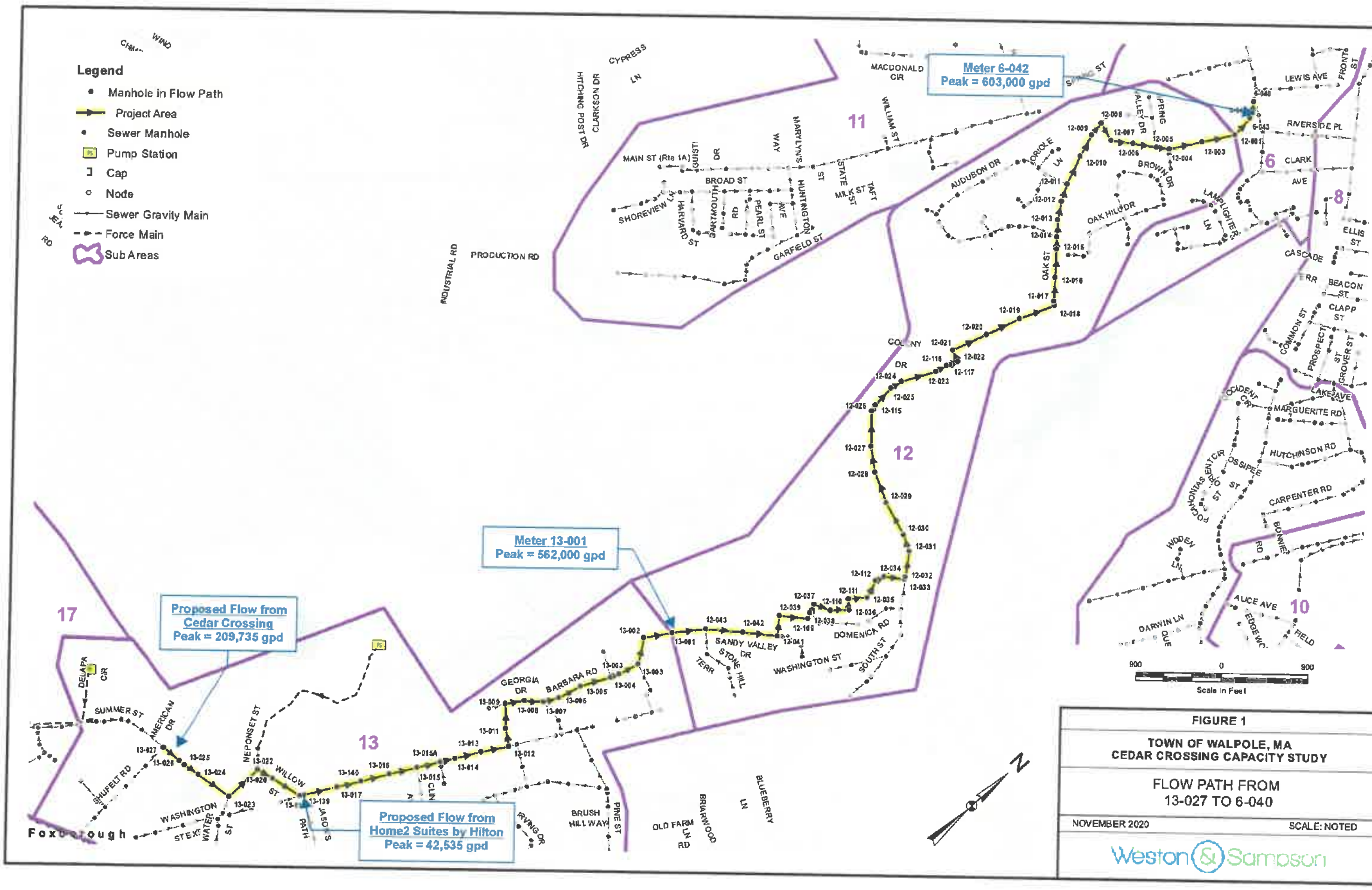
Summary, Conclusions, and Recommendations

Weston & Sampson reviewed existing data from previous investigation, rehabilitation, metering studies, and hydraulic capacity evaluation projects. Using that data plus record drawings, parameters for the theoretical hydraulic capacity analysis were generated. The hydraulic capacity of individual pipes increases and decreases from segment to segment; however, the total hydraulic capacity throughout the flow path remains generally high and consistent. The overall condition of pipelines in the Project Area is generally good.

The hydraulic capacity identified three segments that exceed the design capacity. One segment is shown to be deficient because existing flow for that pipeline is not available and peak flows occurring much farther downstream were used in the calculation. However, it is likely that the peak flows here are significantly lower than the flows used in the table and therefore not noted as an area of concern. Two additional segments shown to be deficient have parallel relief lines which are capable of handling additional flows. Based on our review of existing data and the calculated hydraulic capacity evaluation, the sewers affected by the proposed connection appear capable of handling the proposed additional flow from the development.

Weston & Sampson appreciates the opportunity to work with the Town of Walpole. If you have any questions, please do not hesitate to contact me at 508-728-5557.

FIGURES


Legend
Manhole in Flow Path
Project Area
Sewer Manhole
Pump Station
Cap
Node
Sewer Gravity Main
Force Main
Sub Areas
Meter 6-042
Peak = 603,000 gpd
Meter 13-001
Peak = 562,000 gpd
Proposed Flow from
Cedar Crossing
Peak = 209,735 gpd
Proposed Flow from
Home2 Suites by Hilton
Peak = 42,535 gpd
6
8
10
11
12
13
17
MAIN ST (Rte 1A)
PRODUCTION RD
INDUSTRIAL RD
HITCHING POST DR
CLARKSON DR
CYPRESS LN
MACDONALD CIR
WILLIAM ST
BROAD ST
GARFIELD ST
SHOREVIEW LN
HARVARD ST
DARTMOUTH RD
PEARL ST
HUNTINGTON
STATE ST
MILK ST
TAFT
AUDUBON DR
OAK HILL DR
OAK ST
LAMPLIGHTER LN
BROWN DR
LEWIS AVE
RIVERSIDE PL
CLARK AVE
ELLIS ST
CASCADE TERR
BEACON ST
CLAPP ST
COMMON ST
PROSPECT ST
GROVER ST
LAKE AVE
MARGUERITE RD
HUTCHINSON RD
OSSIPEE
CARPENTER RD
BONNIE RD
POCAHONTAS ST
WIDDEN LN
ALICE AVE
DARWIN LN
COLONY DR
SANDY VALLEY DR
STONE HILL TERR
DOMENICA RD
WASHINGTON ST
SOUTH ST
GEORGIA DR
BARBARA RD
BRUSH HILL WAY
PINE ST
OLD FARM LN RD
BRIARWOOD
BLUEBERRY LN
IRVING DR
JASON'S PATH
WILLOW ST
NEPONSET ST
AMERICAN DR
SUMMER ST
DELAPA CIR
SHUFELT RD
WASHINGTON ST EXT
WATER ST
Foxborough
900 0 900
Scale in Feet
N
FIGURE 1
TOWN OF WALPOLE, MA
CEDAR CROSSING CAPACITY STUDY
FLOW PATH FROM
13-027 TO 6-040
NOVEMBER 2020
SCALE: NOTED
Weston & Sampson

TABLES

TABLE 1
SEWER LINE HYDRAULIC CAPACITY ANALYSIS
CEDAR CROSSING
WALPOLE, MASSACHUSETTS

Location	Upstream MH	Downstream MH	Diameter (in)	Pipe Material	Mannings "n"*	Mannings Capacity (gpd)[1]	Design Capacity (80%) (gpd)	Existing Flow (gpd)[2]	Available Capacity (gpd)[3]	Comments
Summer Street	13-027	13-026	12	PVC	0.010	896,319	717,055	814,270	(97,215)	
Summer Street	13-026	13-025	12	DI	0.012	1,167,808	934,247	814,270	119,977	
Summer Street	13-025	13-024	12	PVC	0.010	4,714,560	3,771,648	814,270	2,957,378	
Summer Street	13-024	13-023	12	DI	0.012	1,167,808	934,247	814,270	119,977	
Neponset Street	13-023	13-022	14	DI	0.012	3,604,143	2,883,315	814,270	2,069,045	
Willow Street	13-022	13-020	15	PVC	0.010	2,363,023	1,890,419	814,270	1,076,149	
Willow Street	13-020	13-018	15	PVC	0.010	2,484,282	1,987,425	814,270	1,173,155	
Washington Street	13-018	13-139	15	PVC	0.010	3,341,820	2,673,456	814,270	1,859,186	
Washington Street	13-139	13-017	15	PVC	0.010	2,484,282	1,987,425	814,270	1,173,155	
Washington Street	13-017	13-140	15	PVC	0.010	2,099,601	1,679,681	814,270	865,411	
Washington Street	13-140	13-016	15	PVC	0.010	6,705,589	5,364,471	814,270	4,550,201	
Washington Street	13-016	13-015	15	PVC	0.010	6,157,240	4,925,792	814,270	4,111,522	
Washington Street	13-015	13-014	15	PVC	0.010	3,513,305	2,810,644	814,270	1,996,374	
Washington Street	13-014	13-013	15	PVC	0.010	2,235,196	1,788,157	814,270	973,887	
Washington Street	13-013	13-012	15	PVC	0.010	2,168,459	1,734,767	814,270	920,497	
Washington Street ESMT	13-012	13-011	15	PVC	0.010	1,954,622	1,563,698	814,270	749,428	
Washington Street ESMT	13-011	13-009	15	PVC	0.010	1,877,940	1,502,352	814,270	688,082	
Georgia Drive	13-009	13-008	15	PVC	0.010	1,084,229	867,384	814,270	53,114	
Georgia Drive	13-008	13-007	15	PVC	0.010	1,877,940	1,502,352	814,270	688,082	
Barbara Road	13-007	13-006	15	PVC	0.010	2,299,998	1,839,998	814,270	1,025,728	
Barbara Road	13-006	13-005	15	PVC	0.010	1,893,525	1,514,820	814,270	700,550	
Barbara Road	13-005	13-004	15	PVC	0.010	1,679,681	1,343,745	814,270	529,475	
Barbara Road	13-004	13-063	15	PVC	0.010	2,816,911	2,253,529	814,270	1,439,259	
Barbara Road	13-063	13-003	15	PVC	0.010	2,099,601	1,679,681	814,270	865,411	
Barbara Road ESMT	13-003	13-002	15	PVC	0.010	1,877,940	1,502,352	814,270	688,082	
Barbara Road ESMT	13-002	13-001	15	PVC	0.010	2,542,743	2,034,195	814,270	1,219,925	
Sandy Valley Drive	13-001	12-043	15	PVC	0.010	2,168,459	1,734,767	855,270	879,497	
Sandy Valley Drive	12-043	12-042	15	PVC	0.010	2,099,601	1,679,681	855,270	824,411	
Sandy Valley Drive	12-042	12-041	15	PVC	0.010	1,901,270	1,521,016	855,270	665,746	
Sandy Valley Drive	12-041	12-039	15	PVC	0.010	3,018,367	2,414,694	855,270	1,559,424	

Location	Upstream MH	Downstream MH	Diameter (in)	Pipe Material	Mannings "n"*	Mannings Capacity (gpd)[1]	Design Capacity (80%) (gpd)	Existing Flow (gpd)[2]	Available Capacity (gpd)[3]	Comments
Sandy Valley Drive ESMT	12-039	12-109	18	RC	0.012	3,368,477	2,694,781	855,270	1,839,511	
Sandy Valley Drive ESMT	12-109	12-038	18	RC	0.012	2,546,329	2,037,063	855,270	1,181,793	
Sandy Valley Drive ESMT	12-038	12-037	18	RC	0.012	3,204,060	2,563,248	855,270	1,707,978	
Sandy Valley Drive ESMT	12-037	12-110	18	RC	0.012	2,846,882	2,277,506	855,270	1,422,236	
Sandy Valley Drive ESMT	12-110	12-036	18	RC	0.012	1,273,164	1,018,532	855,270	163,262	
Sandy Valley Drive ESMT	12-036	12-111	18	RC	0.012	2,846,882	2,277,506	855,270	1,422,236	
Sandy Valley Drive ESMT	12-111	12-035	18	RC	0.012	2,650,303	2,120,243	855,270	1,264,973	
Sandy Valley Drive ESMT	12-035	12-112	18	RC	0.012	2,470,945	1,976,756	855,270	1,121,486	
Sandy Valley Drive ESMT	12-112	12-034	18	RC	0.012	2,940,247	2,352,198	855,270	1,496,928	
Sandy Valley Drive ESMT	12-034	12-033	18	DICL	0.012	869,737	695,790	855,270	(159,480)	has parallel relief sewer
South Street	12-033	12-032	18	DICL	0.012	3,368,477	2,694,781	855,270	1,839,511	
South Street	12-032	12-031	18	DICL	0.012	3,368,477	2,694,781	855,270	1,839,511	
South Street	12-031	12-030	18	DICL	0.012	2,079,069	1,663,255	855,270	807,985	
South Street	12-030	12-029	18	DICL	0.012	4,158,138	3,326,510	855,270	2,471,240	
South Street	12-029	12-028	18	DICL	0.012	4,026,100	3,220,880	855,270	2,365,610	
South Street	12-028	12-027	18	DICL	0.012	1,888,408	1,510,726	855,270	655,456	
South Street	12-027	12-026	18	DICL	0.012	838,099	670,480	855,270	(184,790)	has parallel relief sewer
South Street	12-026	12-115	18	DICL	0.012	1,470,124	1,176,099	855,270	320,829	
South Street	12-115	12-025	18	DICL	0.012	2,079,069	1,663,255	855,270	807,985	
South Street	12-025	12-024	18	DICL	0.012	2,546,329	2,037,063	855,270	1,181,793	
South Street	12-024	12-023	18	DICL	0.012	2,437,924	1,950,339	855,270	1,095,069	
South Street	12-023	12-116	18	DICL	0.012	2,650,303	2,120,243	855,270	1,264,973	
South Street	12-116	12-117	10	DICL	0.012	3,079,455	2,463,564	855,270	1,608,294	triple-barrel siphon
South Street	12-117	12-022	18	DICL	0.012	3,889,582	3,111,665	855,270	2,256,395	
South Street	12-022	12-021	18	DICL	0.012	2,546,329	2,037,063	855,270	1,181,793	
South Street	12-021	12-020	18	RC	0.012	3,447,746	2,758,197	855,270	1,902,927	
South Street	12-020	12-019	18	RC	0.012	2,013,050	1,610,440	855,270	755,170	
South Street	12-019	12-018	18	RC	0.012	2,650,303	2,120,243	855,270	1,264,973	
South Street	12-018	12-017	18	RC	0.012	5,039,330	4,031,464	855,270	3,176,194	
Oak Street	12-017	12-016	18	RC	0.012	2,546,329	2,037,063	855,270	1,181,793	
Oak Street	12-016	12-015	18	RC	0.012	3,287,297	2,629,837	855,270	1,774,567	
Oak Street	12-015	12-014	18	RC	0.012	6,816,683	5,453,347	855,270	4,598,077	
Oak Street	12-014	12-013	18	RC	0.012	6,365,822	5,092,658	855,270	4,237,388	
Oak Street	12-013	12-012	18	RC	0.012	6,574,593	5,259,674	855,270	4,404,404	

Location	Upstream MH	Downstream MH	Diameter (in)	Pipe Material	Mannings "n"*	Mannings Capacity (gpd)[1]	Design Capacity (80%) (gpd)	Existing Flow (gpd)[2]	Available Capacity (gpd)[3]	Comments
Oak Street	12-012	12-011	18	RC	0.012	6,323,241	5,058,593	855,270	4,203,323	
Oak Street	12-011	12-010	18	RC	0.012	6,365,822	5,092,658	855,270	4,237,388	
Oak Street	12-010	12-009	18	RC	0.012	6,016,741	4,813,392	855,270	3,958,122	
Oak Street	12-009	12-008	18	RC	0.012	8,185,302	6,548,242	855,270	5,692,972	
Oak Street ESMT	12-008	12-007	18	RC	0.012	7,567,925	6,054,340	855,270	5,199,070	
Lewis Avenue	12-007	12-006	18	RC	0.012	6,615,557	5,292,445	855,270	4,437,175	
Lewis Avenue	12-006	12-005	18	RC	0.012	11,575,766	9,260,612	855,270	8,405,342	
Lewis Avenue	12-005	12-004	18	RC	0.012	6,736,953	5,389,563	855,270	4,534,293	
Lewis Avenue	12-004	12-003	18	RC	0.012	5,401,579	4,321,264	855,270	3,465,994	
Lewis Avenue	12-003	12-001	18	RC	0.012	9,326,889	7,461,511	855,270	6,606,241	
Lewis Avenue	12-001	6-043	18	RC	0.012	9,355,810	7,484,648	855,270	6,629,378	
Lewis Avenue	6-043	6-042	18	RC	0.012	4,092,651	3,274,121	855,270	2,418,851	
Lewis Avenue	6-042	6-040	18	RC	0.012	3,819,493	3,055,595	855,270	2,200,325	

NOTES:

[1]Capacity assumes clean, circular, non-obtrusive pipes at 100% full.

[2]Existing flow assumes peak flow from metering data plus proposed peak flow from Cedar Crossing and Home2 Suites Hotel.

[3]Available capacity is the design capacity minus the existing flow.